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6. AUTHOR(S)
D. S. Lange

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Space and Naval Warfare Systems Center
San Diego, CA 92152–5001

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The analytical process in many domains is one of associating pieces of preexisting data to form new information. Where the individual data elements are multimedia files, database entries, and computer based models, hypermedia architectures provide natural support for such a process. This paper describes aspects of analysis support that dictate particular requirements in a hypermedia based system. Adaptations of techniques from published hypermedia research were indicated by these requirements. Key among these techniques were anchoring as presented in the Dexter model, perspective filtering and navigation from graph-based hypermedia, link typing from rich hypermedia, and the system structure of open hypermedia systems.

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21a. NAME OF RESPONSIBLE INDIVIDUAL	21b. TELEPHONE *(Include Area Code)*	21c. OFFICE SYMBOL
D. S. Lange	(619) 553-6534	D4223

Hypermedia Potentials for Analysis Support Tools

Douglas S. Lange
Space and Naval Warfare Systems Center
53560 Hull Street
San Diego, CA 92152-5000, USA
Tel: +1 (619) 553-6534
E-mail: dlange@acm.org

ABSTRACT
The analytical process in many domains is one of associating pieces of preexisting data to form new information. Where the individual data elements are multimedia files, database entries, and computer based models, hypermedia architectures provide natural support for such a process. This paper describes aspects of analysis support that dictate particular requirements in a hypermedia based system. Adaptations of techniques from published hypermedia research were indicated by these requirements. Key among these techniques were anchoring as presented in the Dexter model, perspective filtering and navigation from graph-based hypermedia, link typing from rich hypermedia, and the system structure of open hypermedia systems.

KEYWORDS: Analysis, knowledge model, semantic network, perspective filtering, navigation, open hypermedia, Dexter, anchor.

INTRODUCTION
Many hypermedia applications work in information spaces constrained by the level of diversity and quantity of the information, restrictions on the structure of information, or by limited change of the underlying data. Analyst support systems are essentially knowledge management tools that require all of the attributes of hypermedia systems but need to be freed of the constraints listed above. Indeed, it may be that hypermedia architectures are best suited for systems involved in knowledge development and modeling. In such systems, the hypermedia constitutes a semantic model [4] that can be used for reasoning as well as navigation and searching.

A use case analysis was done to support the determination of requirements for an analysis support system. The primary actors found were the author and the reader. However, the customer's view of the future relationship between these two actors corresponded closely to the roles described in a social construction of knowledge [2] rather than a fixed creator and user relationship. Therefore, it is expected that people can serve in both roles nearly simultaneously.

From the detailed scenarios, it can be seen that hypermedia systems ought to provide the desired interactions. Upon further review, it can be seen that there are some requirements that suggest the need to adapt prominent research architectures to support this application of hypermedia.

SCENARIO SUMMARIES
Knowledge Base Generation. Using web based tools, the analyst performs queries on a variety of databases that hold text, imagery, and other media in order to locate content to use. The analyst forms a model of the important concepts, events, entities, and relationships indicated. The analyst attaches raw content to the various elements of the model. If there is a template to follow, the application checks to ensure that the associations being created and the entities represented are legal for this model.

Information Update. A change occurs to content that has been referenced concerning a concept in the knowledge base. It is possible that the model created by the analyst is no longer valid. In order to ensure that a review occurs, notification is sent to the author(s) of elements of the model that are affected by the possible change. These include not only the concepts directly supported by the content, but the associations to other elements as well.

Product Delivery and Use. An information consumer requests information on a certain topic. Either an analyst or a search agent provides a filtered view of the knowledge model to the consumer. Often, the user has additional content to add to the model. When this occurs, the user acts just as the original creator of the knowledge base does in editing the model. Snapshots of the hypermedia model and content are created by users and may be put on CD-ROM or other media to support use away from a network. In this case, changes are stored only on a local disk.

Template Development. For some problems, a predefined template can be generated to guide an analyst. A senior analyst develops a conceptual model of the types of concepts and real-world entities that are essential for a given

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analysis. Types of content and the sources of that content are then attached to the elements of this template model.

CRITICAL REQUIREMENTS FOR ANALYSIS SYSTEM

Reading Data – Adding Associations. Analysts do not create data. They read data from many sources. The value that analysts add to knowledge within the community is in the associations they make among the data elements available. The data may reside in a set of remote disparate databases to which the analysts have been given read-only access. These two aspects of analysts' work map very well to the lower two layers of the Dexter Hypertext Reference Model [1] as well as the separation of structure and content of open hypermedia systems [5]. The storage layer of Dexter comprises the knowledge model being created by the analyst. This model is a semantic network [4]. Anchors provide connections to actual data that describe the atomic nodes of the network. Since analysts may have access to many databases with varying types of data (e.g., images and text reports), several pieces of data may describe the concept or real-world object represented by a particular atomic node. Therefore, multiple anchors per atomic node are essential.

Large Open Ended Schema. In order for the hypermedia to model the domain being analyzed, atomic nodes must represent concepts within the domain rather than represent the multimedia data itself [3]. Rather than have multiple nodes representing documents and images concerning an entity, a single node represents the entity and the multiple content objects can be attached through anchors. In this way, the typed relationships designated by links refer to relationships among the domain objects rather than relationships among information content objects. This differs from approaches that allow only a single anchor per atomic node. Such a restriction causes the node to represent the content rather than a domain concept preventing the hypertext from representing knowledge of the domain.

Atomic nodes and links in an analysis hypermedia need to be typed and a schema can be created of expected or allowable relationships among the nodes. The schema can form the basis of a template. Analysts can be constrained or prompted, using the schema, to enter the correct types of atomic nodes and links and to attach the correct kinds of content for a particular problem. Analysis is however an open ended proposition. Schemas imply an ability to predict all of the types of information to be used and the entire range of associations that will exist among the elements. Analysis support systems should allow dynamic extension of the schema in some way to accommodate unpredicted information.

Unlike the examples given in [1], much of the data that needs to be anchored for an analysis system is not in the form of multimedia objects. Some of the data consists of records within a relational database or as results from an external system. Therefore, the anchors must consist of queries to remote databases or remote methods on system wrappers, and the results provided. In many cases, it is difficult to retrieve only a single item based on such a query and thus some form of ambiguity resolution is needed to select the correct piece of information.

Analysis schemas and instance sets can become quite large. The problems being modeled are quite complex. The size of the schema represents the complexity of the model, while the size of the instance set represents the quantity of information. Consumers of the analysis model must be able to filter both in terms of complexity and in terms of size of the knowledge base that they work with.

Distant and Diverse Customers. Consumers of analysis are often remotely located relative to the information source. A wide range of throughput values must be taken into consideration when designing a system that will serve remote users. If every action by the user causes network communications to be initiated, performance may suffer.

Link Equality. Although hypermedia relies on associations between elements for its character (often using links), much of the interaction described in research is still focused on the content (e.g., string matching filters and searches, searches on image metadata). Links are primarily used for navigation. Since the primary value added by analysts is found in the associations among elements, authors and readers of the products need to interact with typed links in ways other than simply using them for navigation. Links can convey critical information.

CONCLUSIONS

Hypermedia may be the most accessible means for producing knowledge bases by and for end users. Modification of the concepts of anchors, schemas, and filters and the use of an open hypermedia architecture, allow hypermedia management and interaction schemes to be used for working with a semantic network that also provides access to foundational data:

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